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PERMANGANATE OF POTASSIUM :  
*ITS ACTION AND USES.*

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FROM  
THE MEDICAL NEWS,  
November 22, 1884.







## PERMANGANATE OF POTASSIUM :

### ITS ACTION AND USES.

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THERE is a general feeling of uncertainty regarding the real value of the permanganate of potassium as a remedy. Sharing in this to some extent, and desirous of arriving at definite conclusions, I have undertaken to collect the available evidence. This consists, chiefly, of clinical observation, and my own has been supplemented by such published experiences as have rewarded my search of authorities.

The prime objection of contemporary writers is, that permanganate is so quickly decomposed on coming into contact with organic matter, that its powers must then cease. I have, however, given reasons for supposing that the diffusibility of this salt is so rapid, that it has some action on the blood. For example : When used locally for the bite of a venomous serpent, the poison is destroyed, notwithstanding the organic matter in which it is enclosed. Before discussing its actions and uses, its physical and chemical qualities should be stated.

According to the United States Pharmacopœia, permanganate of potassium occurs in "deep, purple-

violet, or nearly black, needle-shaped rhombic prisms, of a metallic lustre, permanent in the air, odorless, having a sweet, afterward disagreeable, astringent taste, and a neutral reaction. Soluble, with the exception of a scanty brown residue, in 20 parts of water at  $59^{\circ}$  Fah. ( $15^{\circ}$  C.), and in 3 parts of boiling water."

According to the new notation, permanganate of potassium is represented by the formula  $K_2Mn_2O_8$ ; and to the old,  $KO.Mn_2O_7$ . It is remarkable for the quantity of oxygen which it contains, and for the readiness with which it yields it up in its most active form, or as ozone;—yields it up so readily that it is one of the reagents used to determine the presence of organic matter in potable waters. This process illustrates one of the functions performed by permanganate of potassium in the human economy. The fine purple color of the solution of this salt in pure water is quickly discharged when brought into contact with organic matter; the oxygen seizes on and oxidizes the organic matter, and the permanganate is reduced correspondingly, the color changing to a dirty brown. It is this oxidizing power for which this salt is now employed as a deodorant and antiseptic.

The foul odors arising from decomposing organic matter are due chiefly to the compounds of hydrogen with sulphur and phosphorus—the sulphide and phosphide of hydrogen and some other products. The oxygen in its nascent state seizes on the hydrogen, and sulphur and phosphorus are set free, whence the destruction of odor. The chemical action which removes foul odors, does not, necessarily, imply the destruction of germs and other *materies morbi*. Bacteria, micrococci, and other minute organisms, so often associated with the ordinary products of putre-



factive decomposition, are now known to be the cause of, or at least to convey, the poison of some diseases. Active oxygen, or ozone, or nascent oxygen, has an oxidizing or destroying action on some of these pathogenic agents, and hence permanganate of potasssum, whilst a deodorant, is also antiseptic.

Brought in contact with snake poison it destroys its toxic power. Thus, as Lacerda was the first to show, if inserted into the wound made by a noxious reptile, the poison is decomposed, and, consequently, has no effect on the system.<sup>1</sup> Lacerda, it is true, supposed that this agent would prove equally effective when administered by the stomach—that it would antagonize and render harmless the poison introduced at any point; but this supposition has proved to be erroneous. The effect of permanganate of potassium on animal poison is chemical; it is antidotal, but not physiologically antagonistic; and hence to be effective it must be brought into immediate contact with the poison, which is oxidized and its power thus destroyed.

Brought in contact with the tissues of the body, permanganate of potassium has an effect determined by the condition of the part. On the unbroken integument external and internal (mucous membrane), it does not have an irritant action, but the oxygen readily assails the uncovered tissue. It stains the skin a brownish color, and applied to an abrasion causes considerable smarting and burning, and is very superficially caustic. In small doses (two or three grains) well diluted, it does not irritate the stomach, but if the dose be large and in a solution too concentrated it causes local heat, a sense of irritation, even burning pain. The effect of a large

<sup>1</sup> Bulletin Gén. de Thérap. Vol. 101, p. 325, and vol. 104, p. 556.

dose, insufficiently diluted, is, doubtless, chiefly local; but if given in sufficient water on an empty stomach, diffusion into the blood probably takes place to some extent.

The systemic action of permanganate of potassium may be studied in several modes: the effect of the salt as a whole; the effects of its chief constituent, active oxygen or ozone.

It has been alleged that this salt cannot act beyond the stomach, because there its oxygen must be appropriated by the organic matter contained in that organ and the mucous membrane, but certain physiological and clinical facts support the opinion above expressed regarding its diffusion into the blood. Vulpian<sup>1</sup> has studied the effects produced by this remedy when thrown directly into the veins. This mode of experimentation is open to many objections. The bulk of the material injected into the veins, were it water merely, must, and as we know, does have an effect on the functions of the circulatory organs. Furthermore, the emboli produced by the chemical action of the salt on the formed elements and on the fibrin, must of necessity cause serious disturbances at widely separated points and in various functions. The results he noted were of two kinds, consisting of chemical changes in the blood, and the effects of the salt at the points of elimination. In the first category were pulmonary infarctions, dissolved corpuscles, bloody urine and ecchymoses; in the second, were congestion of the gastro-intestinal mucous membrane, and of the kidneys. Obviously such experiences are not characteristic, for they follow the injection into the blood of various chemical agents.

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<sup>1</sup> Bulletin Gén. de Thérap. Vol. 102, p. 251.

As the chief, if not the only therapeutic effects of permanganate of potassium, are due to its oxygen, it is most important to ascertain the effects of this agent. The modern investigations, especially those of Demarquay<sup>1</sup> and Hayem,<sup>2</sup> of France; Waldenburg,<sup>3</sup> of Germany; Birch<sup>4</sup> and Mackey,<sup>5</sup> of England; and A. H. Smith,<sup>6</sup> of New York, have thrown a flood of light on the actions and uses of this agent. More recently the researches of Binz<sup>7</sup> on the effects of ozone have been successful in clearing up much of the mystery surrounding the physiological actions of this peculiar form of oxygen. The results of the action of oxygen thus studied, are quite in harmony with *a priori* conceptions. On the most superficial view, it would be regarded as a vital stimulant, and as an agent promoting the activity of the combustion process in all parts of the body. This notion of its actions is supported by investigation made by the various observers above mentioned.

The recent studies of Binz<sup>8</sup> of the effects of ozone, are peculiarly instructive. He finds that ozone has a hypnotic action, a calmative effect on the central nervous system, due, he supposes, to an impression on the cells of the gray matter, whereby their functional activity is suspended. In some trials on his own person, he experienced the following results: his respiration became deeper and more easy and he

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<sup>1</sup> Essai de Pneumatologie Médicale, etc. Paris, 1866.

<sup>2</sup> Bull. Gén. de Thérap.

<sup>3</sup> Die locale Behandlung der Krankheiten der Athmungsorgane. Berlin, 1872. P. 620 *et seq.*

<sup>4</sup> The Therapeutic Action of Oxygen. London, 1857, and British Med. Journal, December 24 and 31, 1859.

<sup>5</sup> The Practitioner. Vol. 2, p. 278.

<sup>6</sup> The New York Medical Journal. Vol. 71, p. 152.

<sup>7</sup> Berliner klin. Wochenschrift, No. 43, 1882.

<sup>8</sup> Ibid., *op. cit.*



had that feeling of well-being produced in the healthy by the respiration of a pure and exhilarating atmosphere. Some drowsiness came on, with an agreeable languor, and afterwards there was experienced some heaviness in the head (hebetude), together with a general sense of fatigue, but no other disagreeable sensations.

The powers possessed by the permanganate of potassium as a general stimulant are well exhibited in the active emmenagogue property which it has been shown to possess by Drs. Ringer and Murrell. In cases of amenorrhoea due to deficient activity, it seems to promote the function in a remarkable degree. The same power, which can so stimulate the sexual functions, must, when exerted in other directions, prove equally effective.

*Mode of prescribing permanganate of potassium.* As this salt is so readily decomposed, yielding up its oxygen to any organic matter present, it is obviously necessary to be very careful in preparing and administering it. It should be given dissolved in pure water, or in compressed tablets or pellets. I have used the compressed tablets of Messrs. John Wyeth & Brother, of Philadelphia, which contain no excipient, and are, therefore, entirely free from objection, the material being simply compressed without the addition of any foreign material. They are readily administered in this form, or they can be dissolved in pure water, whenever a solution is desired. These tablets are typically adapted to the purpose—indeed present advantages not possessed by any other possible mode of administration.

Ordinary distilled water after standing a few hours exposed to the air, begins to exhibit evidences of turbidity, due to the growth of an organism, a penicillum, and after some days it becomes so much



clouded with organic matter as to be unfit for the solution of permanganate of potassium. River water or rain water boiled and filtered may suffice for immediate use, but whenever it can be obtained, fresh distilled water should be employed for this purpose. A pellet of this salt may be used to determine the requisite freedom from organic matter. Dropped into the water under examination, the beautiful violet color imparted to it should not be discharged. The prompt disappearance of the color signifies the presence of chemical agencies fatal to the permanence of the salt. The solution should be well diluted when taken, and should be given when the stomach is empty. A small dose repeated at short intervals, say a grain or two every half-hour, until four or six grains have been taken, is preferable to the exhibition of this amount at one dose. Given in this way, and commencing the administration in about four hours after meals, the diffusion of the salt into the blood is, probably, secured. There are two periods during the day, when the administration of the remedy can be practised—the proper interval after breakfast, and after dinner or luncheon. The same considerations should govern the administration of the pellets or compressed pills, undissolved, and sufficient pure water should be taken after them.

*Therapeutic applications.* On the chemical actions of permanganate of potassium we have a sure basis on which to construct a systematic therapy. The readiness with which this salt parts with its oxygen, is urged against its real utility as a remedy, but for reasons already given it is concluded that this action does not occur with sufficient promptitude to prevent its diffusion into the blood to some extent, otherwise we should in vain try to account for its practical utility.

Having more or less irritating quality, permanganate of potassium is contraindicated in cases of acute inflammation of the stomach. It is specially indicated in chronic *gastric and gastro-intestinal catarrh*, accompanied by fermentative changes in the food. Eructations of gas, vomiting of a yeast-like material containing *sarcinæ*, and an acid fermentation of the starchy and saccharine constituents of the food, are relieved often very promptly by the administration of this salt. As the action is intended to be restricted to the stomach contents, the proper time for the administration of the remedy is two or three hours after meals.

When the catarrhal process extends into the duodenum, and involves also the bile-ducts, this remedy has seemed to be highly efficient. Beside the evidences of stomachal and intestinal indigestion there is present more or less biliousness, manifested in a muddy complexion, yellow conjunctiva, high-colored urine and a general *malaise* due to the presence in the blood of immature materials and unoxidized products of the retrograde metamorphosis. This is a very common state of things and is the result of several factors: improper feeding, catarrh of the gastro-intestinal and hepatic mucous membrane, and imperfect preparation of the food for absorption. The permanganate, in this condition of things, does good in several directions: it checks fermentation of the food elements prone to this process, acts favorably on the catarrh of the mucous membrane, but especially promotes oxidation in the tissues undergoing metamorphosis, and whilst it thus stimulates metabolism, helps to consume in the normal way the products of waste. Uric acid which appears in the urine, under the action of permanganate of potas-

sium is converted into urea, the form in which it is normally excreted.

It follows from the foregoing considerations, that permanganate of potassium is a remedy of great value in *lithæmia*. Clinical experience is quite in harmony with physiological deductions. In giving this remedy in this affection, two purposes may be accomplished by it: the catarrh of the mucous membrane and the fermentation of the foods may be favorably influenced, and the insufficient oxidation manifested by an excess of urid acid in the urine, may be wholly relieved.

It follows, also, from the foregoing considerations that permanganate of potassium must be useful in an affection cognate to lithæmia—the hepatic form of glycosuria, and in this instance, again, clinical experience confirms physiological observation. The special field of its usefulness in relation to diabetes, is in those cases in which there appears to be both overproduction of glycogen, and insufficient consumption, or combustion, or oxidation of this material. It will be found most beneficial in the obese subjects of glycosuria, in whom the presence of much uric acid in the blood signifies at the same time inadequate preparation for absorption of certain food constituents and a supply of oxygen insufficient to convert uric acid into urea. In other forms of diabetes, especially of nervous origin, permanganate of potassium has no beneficial effect.

For the same reason that this salt is useful in lithæmia and glycosuria, it is a remedy for obesity. According to the observation of the writer, there is no remedy more effective than this in the treatment of *obesity*, and for the relief of the disorders of digestion which have a pathogenic relation to this malady. Of course, certain changes in the diet must be made

and active exercise enjoined, but the good effects of the remedy are manifest without any aid from a change in diet and from exercise. The *methodus modendi*, is, so to speak, of the physiological order. The surplus and useless material, such as under existing circumstances is transformed into fat, is oxidized and consumed, and is excreted as carbonic acid and water. As it acts thus, to increase the performance of a function, obviously the curative effect is an exercise of a physiological power, and different from all the usual remedies for obesity, does not operate injuriously if used with the least discretion.

One of the most important therapeutical applications of the permanganate of potassium, and a recent discovery, is in the treatment of *amenorrhœa*. We owe this valuable improvement, as indeed many others, to Drs. Ringer and Murrell. They have shown that this remedy is remarkably certain when applied in suitable cases. Given in doses of two to five grains three times a day, for several days preceding the menstrual molimen, this agent is quite sure to start the flow. The kind of case to which the permanganate is adapted is that characterized by torpor, anæmia, or deficient activity of the menstrual apparatus. On the other hand, it is contraindicated whenever an acute congestion or a general condition of sthenic reaction exists. Confirmatory evidence has been offered in this country, as well as in England and on the Continent. For example, we find the following coming from Russia: Dr. S. M. Lvaff prescribed it in ten cases of *amenorrhœa*. In seven of these the remedy succeeded—the menstrual function was restored to its normal activity.<sup>1</sup> The good results achieved by the use of the permanganate in

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<sup>1</sup> Medicinskt Vestnik, No. 43, 1883. Quoted.



amenorrhœa induced Dr. A. V. Vargunin to essay its administration in *dysmenorrhœa*, characterized by scanty menstruation and anæmia. In this case, also, the result was fortunate, and complete relief was obtained.<sup>1</sup> Congestive or mechanical dysmenorrhœa are conditions not suitable for the action of such a remedy.

It is probable that *functional impotence* in the male will be improved by this remedy, provided the conditions present are those of anæmia and depression.

*Topical and Disinfectant Uses.*—Permanganate of potassium has long been known as a disinfectant and deodorizer. Since the agency of minute organisms, as bacteria, bacilli, micrococci, etc., in setting up septic processes in the body, has been established, the various substances employed as disinfectants have been assigned to different relative positions, for now the important point is to procure the death of the living germs and their progeny. An agent destroying foul odors does not necessarily, does not indeed usually, destroy the germs of disease.

The permanganate of potassium is to be classed with the "deodorizers" rather than with the "antiseptics." From this point of view it is an "elegant" disinfectant. In an elaborate research on the antiseptics and their power to destroy bacteria, Bucholtz<sup>2</sup> does not include this salt amongst the list of agents possessing the power to destroy bacteria and similar organisms. Again, M. Ratimoff,<sup>3</sup> in a paper on antiseptics and the results of their use in surgical practice, has, also, ignored the permanganate, not

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<sup>1</sup> Vrach, No. 3, 1884. Quoted.

<sup>2</sup> Antiseptica und Bakterien. Archiv f. experimentelle. Pathologie und Pharmakologie. Band iv. p. 1.

<sup>3</sup> Archives de Physiologie normale et pathologique. Vol. 4, 3d series, p. 142.

mentioning it amongst those agents that have true antiseptic power. The most thorough, and from the modern point of view the most scientific, treatment of the subject of antiseptics is the essay of Dr. Miguel.<sup>1</sup> He assigns permanganate of potassium to a group containing the salts of lead, zinc, nickel, and cobalt, alum, tannin, the mineral acids, and other agents. The first group is composed of "substances eminently antiseptic;" the second of "substances very strongly antiseptic;" the third of "substances strongly antiseptic;" the fourth of "substances moderately antiseptic;" the fifth of "substances feebly antiseptic," and the sixth of "substances very feebly antiseptic." Permanganate of potassium, in a list of 91 agents having qualities more or less antiseptic, stands 44, the bichloride of mercury being first. The important point, however, to be determined, in respect to the powers of any antiseptic, is its effect on the vitality of living germs or microbes. In the attempt to ascertain this quality of any antiseptic, certain precautions must be observed if the results are to possess any real value. These precautions have been well stated in a memoir of N. Jalan de la Croix,<sup>2</sup> whose experimental inquiry was conducted under the observation of Prof. Dragendorff.

Bacteria developed in different liquids do not possess the same power of resistance to the action of antiseptics; they resist more successfully when contained in their native fluid than when in culture solutions. The same facts are true of the spores, which are sterilized with more difficulty in their

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<sup>1</sup> Bul. Gén. de Thérap. Vol. 107, p. 80 *et seq.*

<sup>2</sup> Das Verhalten der Bacterien das Fleisch-Wassers gegen einige Antiseptica. Archiv für experimentelle Pathologie und Pharmacologie. 1881. Pp. 175 and 225.

native element than when transplanted into foreign fluids.

Most of the experiments made have been with microbes contained in culture-fluids; for example, the very able and elaborate research made by Dr. Sternberg.<sup>1</sup> Under these circumstances the results are better than can be achieved from the use of the same antiseptics in disease, *cæteris paribus*. Sternberg assigns to bichloride of mercury (mercuric bichloride) the first place as an antiseptic; yet he puts permanganate of potassium second. Whilst bichloride is effective in the proportion of 1 part in 20,000 of fluid, the permanganate of potassium acts to the same degree in the proportion of 1 part to 833 of solution. The bichloride is, therefore, about twenty-five times more efficient. We must acknowledge a certain sense of scepticism in examining these experiments of Dr. Sternberg, as able and well-considered as they unquestionably are. We find it difficult to understand why liquor zinci chloridi has no germicide action, whilst a 2 per cent. solution of the same is effective in the proportion of 1 part to 50. As the experiments of Dr. Miguel have been more recently performed, and the conditions insisted on by Jalan de la Croix more perfectly observed, we may rather accept his conclusions in regard to the real value of permanganate of potassium as a germicide.

As a deodorant, and so far a disinfectant, this agent has a large sphere of usefulness in medical practice. Sufficiently concentrated, it has an effect on the constitution of certain animal poisons. The fact first ascertained by Lacerda—that permanganate

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<sup>1</sup> Experiments to Determine the Germicide Value of Therapeutic Agents. By Geo. M. Sternberg, M.D., U. S. A. American Journal of Medical Sciences, April, 1883.

of potassium decomposes and renders harmless the poison of venomous snakes—seems to contradict the results of the experimental investigations regarding its germicide power. The destruction of the animal poison takes place on contact, but the same agent is completely inefficient when acting through the whole mass of the blood. It is, however, a question of the strength in which the permanganate is used. Topically, it is possible to make applications strong enough to decompose animal poisons without, at the same time, injuring the textures to which they are adherent.

In *gonorrhœa*, *leucorrhœa*, and *suppurating buboes*, a strong solution—five to ten grains to the ounce—is an efficient remedy. It has proved to be especially so in *gonorrhœa*. When the attack is recent, the solution should not be stronger than two grains to the ounce, but, the more chronic, the stronger the injection may be made, of course within reasonable limits. In *suppurating buboes*, the contents of the sac should be drawn off with an aspirator if still intact, or thoroughly evacuated if ruptured, and the cavity filled with the stronger solution mentioned above.

Lacerda's experience with permanganate in snake poison renders it almost certain that in the corresponding poison of syphilis the local application of this remedy at the earliest moment to an infecting chancre may be productive of the best results. In all forms of unhealthy and sloughing syphilitic sores—in sloughing phagedæna, for example—it deserves more extended use than has heretofore been made. Finely pulverized, it can be dusted thoroughly over the diseased surface and introduced into all the sinuosities. By the same mode of application it can be used in *lupus* and *epithelioma*, and will, doubt-



less, be found more effective than the chlorate of potassium, which, applied in this way, has lately been much urged on the attention of the profession.

As a disinfectant and deodorant, a solution of two to five grains to the ounce is useful in *otorrhœa*, *ozæna*, *fetid breath*, *fetid sweat of the axilla and feet*, and in general wherever on the surface of the body there are odorous discharges and emanations. For general disinfectant purposes it is rather an expensive agent, even if equal to the active and cheaper agents now utilized for this purpose.

As has been already stated, permanganate of potassium is the most generally useful test for determining the presence and amount of organic matter in potable waters, a standardized solution being employed. It may, also, be used to free drinking water from dangerous impurities when the drinking of contaminated water may be imperative.







